



Authorizations and Permits for Protected Species (APPS)

File #: 23200

Title: Abundance, recruitment and migratory dynamics

Modification: 3

File Number: 23200

Applicant Information

Affiliation: UNC Wilmington

Address: 601 S. College Rd.

City,State,Zip: Wilmington, NC 28403

Project Information

File Number: 23200

Application Status: Application Complete

Project Title: Abundance, recruitment and migratory dynamics of sturgeon in North Carolina rivers and estuaries

Project Status: New

**Previous Federal or
State
Permit/Authorization:**

**Permit/Authorization
Requested:** • ESA Section 10(a)(1)(A) permit (other) - Issued

**Where will activities
occur?** US Locations including offshore waters

Research Timeframe: Start: 01/31/2020 End: 01/31/2025

**Sampling
Season/Project
Duration:**

Sampling will occur during spring, summer, and fall. The sampling strategy will be adaptive to capture adult and juvenile life stages, and to monitor movement and distribution patterns of acoustically tagged individuals.

Abstract:

US Atlantic coastal rivers have historically supported two species of sturgeons. Shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) are listed as endangered under the Endangered Species Act. Shortnose sturgeon appear to be rare in North Carolina systems, but small populations may remain in some rivers. North Carolina waters could support multiple spawning populations of Atlantic sturgeon that contribute to the Carolina distinct population segment (DPS). Since Atlantic sturgeon were classified as Endangered in 2012, information on the population status in many southern US rivers is limited, particularly in North Carolina waters. The goal of this study is to gain a better understanding of the demographics of riverine populations of Atlantic and shortnose sturgeon in the coastal rivers of North Carolina through the application of mark-recapture, acoustic telemetry, and genetic sampling within the four largest drainage basins in the state: Cape Fear River, Neuse River, Tar-Pamlico River system, and the Roanoke/Chowan River system. A maximum of 560 juvenile, and 700 subadult/adult Atlantic sturgeon will be captured annually throughout the state, with a subset of up to 78 subadults/adult and 65 juvenile Atlantic sturgeon being fitted with acoustic tags. For shortnose sturgeon, we are proposing annual capture of up to 60 juveniles (up to 15 per any river) and up to 60 adults/sub-adults (up to 15 per any river) throughout the state. Acoustically-tagged Atlantic sturgeon will be detected using stationary receivers deployed in each system and also through active tracking. All captured individuals of both species will be measured, weighed, PIT-tagged (if one is not already present), and sampled for aging and genetics through removal of secondary fin ray tissue.

Project Description

Purpose: Objectives of this study are to gain information about the abundance, distribution, habitat use, and migration dynamics of sturgeon in North Carolina waters. The study results will help in designing more effective sampling programs and in interpreting the status of the species within the Carolina DPS. Telemetry data can also be used to estimate survival rates, which will aid in constructing population models, and to determine the success of recently constructed aids to fish migration. Few studies of sturgeon have been conducted in North Carolina waters. Armstrong and Hightower (2002) used acoustic telemetry to monitor the short-term movements and distribution of juvenile Atlantic sturgeon in Albemarle Sound. Moser and Ross (1995) examined the distribution and habitat use of shortnose sturgeon and juvenile Atlantic sturgeon in the Cape Fear River. More recently, Flowers and Hightower (2015) used sidescan sonar to estimate abundance of Atlantic sturgeon in multiple NC and SC river systems. No studies in NC waters have been conducted to examine the movements and habitat use of adult Atlantic sturgeon, while catches of shortnose sturgeon are exceedingly rare. In addition, advances in transmitter battery life and detection capabilities of submersible receivers in recent years should contribute to a more thorough understanding of the movements of sturgeon within NC systems. The arrays of submersible receivers that exist in many of the river systems in NC have the potential to dramatically increase our knowledge about sturgeon migration and habitat use. A sample size of 20 subadult/adult and 20 juvenile acoustically-tagged Atlantic sturgeon per year per watershed (Cape Fear River, Neuse River, Tar/Pamlico River, Roanoke/Chowan River) is projected (n will be limited to 18 adults and 5 juveniles in the Roanoke/Chowan system). Based on historical and recent estimates of abundance for Atlantic sturgeon, this is expected to produce valid information about habitat use and movement. A statewide sample size of 60 adult shortnose sturgeon per year (up to 15 per watershed), as well as 60 juvenile shortnose sturgeon per year (up to 15 per watershed), is estimated to be sufficient to estimate presence/absence, and monitor movement and habitat use for this species. All captured shortnose sturgeon will be measured, weighed, PIT-tagged (if one is not already present), and sampled for aging and genetics through removal of secondary fin ray tissue for the purposes of quantifying population demographic traits and genetic composition unique to each watershed. To estimate annual recruitment of Atlantic sturgeon, we plan to apply mark-recapture approaches to juvenile life stages, similar to those used effectively in other southeastern US states (e.g., Schueller and Peterson 2010, Bahr and Peterson 2016). This will involve capture and marking of up to 560 juvenile Atlantic sturgeon per year, with 260 captures per year allocated to the Cape Fear River system, and the remaining 300 captures divided equally among the other three large watersheds (Neuse River, Tar-Pamlico River, Roanoke/Chowan River). All captured juvenile Atlantic sturgeon will be measured, weighed, PIT-tagged (if one is not already present), and sampled for aging and genetics through removal of secondary fin ray tissue for the purposes of quantifying population demographic traits and genetic composition unique to each watershed. To assess adult

Atlantic sturgeon abundance, we also plan to tag/recapture individuals using approaches to recent work completed in the York River to estimate adult abundance, survival, and spawning (Kahn et al. 2019, Kahn et al. In Review). Annually, as many as 175 adult Atlantic sturgeon per river system are likely to be captured, photographed, weighed, tissue sampled, PIT tagged, T-bar tagged, as these approaches will inform river-specific demography, genetic composition, and habitat use. Acoustically tagged Atlantic sturgeon (up to 20 adults and juveniles per year in each system) will represent a subset of the total numbers sampled that are given above. There is not a suitable surrogate for Atlantic or shortnose sturgeon, given their unique use of riverine, estuarine, and oceanic habitats at different life stages and seasons. The information produced will be of direct use to NOAA Fisheries in development/revision of recovery plans, and in future status assessments for each species.

Description: General description: We propose to capture, measure and weigh, genetic tissue sample, and PIT tag up to 560 juvenile and 700 adult/sub-adult Atlantic sturgeon annually within NC systems. A maximum of 78 adult and 65 juvenile Atlantic sturgeon annually statewide would be anesthetized and implanted with acoustic transmitters to monitor movement and migration. We propose to capture, measure and weigh, genetic tissue sample, and PIT tag up to 60 juvenile and 60 subadult/adult shortnose sturgeon annually within NC systems. Juvenile and adult sturgeon sampling will occur in the watersheds of the Cape Fear, Neuse, Tar-Pamlico, and Roanoke/Chowan river systems. All sampling will be conducted following the guidelines outlined in Moser et al. (2000) and Kahn and Mohead (2010).

Definition of sturgeon life stages: We define small juvenile Atlantic sturgeon as <500 mm fork length (FL), juvenile Atlantic sturgeon between 500mm and 1000mm FL; sub-adult Atlantic sturgeon between 1000mm and 1300 mm FL) and adult Atlantic sturgeon as >1300 mm FL. We also define juvenile shortnose sturgeon as <450 mm FL, sub-adults between 450mm and 600 mm FL, and adults as >600 mm FL.

Description of the Action Areas:

Cape Fear River Basin:

The Cape Fear River Basin is the state's largest river basin. The river basin is located entirely within the state's boundaries and flows southeast from the north central piedmont region near Greensboro to the Atlantic Ocean near Wilmington. The Cape Fear River is formed at the confluence of the Haw and Deep Rivers on the border of Chatham and Lee counties, just below the B. Everett Jordan Reservoir dam. From there, the river flows across the coastal plain past Fayetteville through three locks and dams to Wilmington before entering the ocean. The Black and Northeast Cape Fear River are each blackwater rivers meeting the Cape Fear River in Brunswick County. Over one-half of the land in the river basin is forested. The action area requested for sturgeon research on the Cape Fear River Basin extends from about four river kilometers below Wilmington, NC, to Lock and Dam #2 located near Elizabethtown, NC. Additionally, all branches and tributaries within the Cape Fear River Basin (east of Lock and Dam #1), including the Black and Northeast Cape Fear Rivers, would be potential sampling sites.

Neuse River Basin:

The Neuse River basin originates in Person and Orange counties and flows from the piedmont region of NC to the outer coastal plain. The river is essentially freshwater from its headwaters to New Bern, where it broadens and assumes estuarine characteristics. The river basin encompasses more than 6,200 square miles, and contains 77 incorporated municipalities, including all or portions of the cities of Raleigh, Durham, Smithfield, Wilson, Goldsboro, New Bern and Havelock. The action area requested for sturgeon research on the Neuse River Basin extends from just below Goldsboro, NC, in the piedmont to the coastal plain near New Bern, NC.

Tar-Pamlico River Basin:

The Tar-Pamlico River basin originates in Person and Granville counties and flows from the piedmont region to the outer coastal plain. The river is essentially freshwater from its headwaters to Washington, NC, where it broadens and begins to assume estuarine characteristics. The watershed encompasses more than 6,400 square miles, and contains 29 incorporated municipalities, including all or portions of the cities and towns of Oxford, Henderson, Louisburg, Nashville, Red Oak, Dertches, Rocky Mount, Tarboro, Greenville, Washington, Bellhaven and Stonewall. The action area requested for sturgeon research on the Tar-Pamlico River Basin extends from Rocky Mount, NC, in the

piedmont region to the coastal plain in Washington, NC.

Chowan River Basin:

The Chowan River Basin is located in the northeastern region of the coastal plain of NC and also southeastern VA and occupies approximately 5,415 square miles. The basin is part of the Albemarle-Pamlico National Estuary Program. Approximately 75 percent of the basin (4,061 square miles) is located in the VA portion of the watershed, with the remaining 1,378 square miles in NC. The river is formed at the border of NC and VA by the confluence of the Nottoway and Blackwater Rivers. A third major tributary, the Meherrin River, joins the Chowan River south of the VA border. The action area requested for sturgeon research in the Chowan River Basin extends from the mouth of Chowan River at Albemarle Sound (6 km south of the Hwy 17 bridge) to the upper reaches of the river basin in Virginia (including the tributaries Blackwater, Nottoway and Meherrin Rivers). The first dam is located at Emporia, VA on the Meherrin River at the intersection of Interstate 95.

Roanoke River Basin:

The Roanoke River Basin begins in the Blue Ridge Mountains of northwestern VA and flows for more than 400 miles in a generally southeastern direction, emptying into Albemarle Sound in northeastern NC. At the fall line near Roanoke Rapids, the drainage area is nearly 8,000 square miles; from Roanoke Rapids to the coast, the river drains another 2,000 square miles. About 36 percent of the watershed is within NC with the remainder in VA; much of the NC portion is comprised by the Dan River and its tributaries. The action area requested for sturgeon research on the Roanoke River Basin extends four kilometers from the mouth of Roanoke River into Albemarle Sound (including Bachelor Bay) to the base of the first impassible dam located at Roanoke Rapids (rkm 221). Additionally, all branches and tributaries within the Roanoke River Basin would be potential sampling sites.

Proposed research in each action area:

Cape Fear River

The primary research questions to be addressed in the Cape Fear River include the documentation of adult spawning-capable Atlantic sturgeon in this river system, assessing the passage of adults beyond the recently constructed rock arch ramp at Lock and Dam #1, and estimation of annual recruitment using mark-recapture of juvenile Atlantic sturgeon.

We plan to target adult Atlantic sturgeon using gill nets during both spring and fall in locations previously shown to hold sturgeon based on sampling by our NC co-investigators. Adult fish will receive three marks: PIT tags, T-bar tags, and fin clips for genetic identification. A subset of individuals (up to 20) will receive acoustic transmitters, implanted surgically. Telemetry studies will provide insight into migratory behavior, habitat use, spawn timing, spawning location, survival, and also will provide specific information related to passage of adult sturgeon over the rock arch ramp at Lock and Dam #1 (the lower most impediment to migration in the Cape Fear River). A network of submersible acoustic receivers will be maintained through a partnership between lead PI Scharf and NCDMF co-investigators to facilitate the tracking of tagged adult sturgeon. Genetic information will provide insight into whether neighboring populations are closely related and whether unique management strategies for this population are appropriate. Past research (Kahn et al. 2019) has shown that to estimate the super-population abundance of a river, one more year than the maximum spawning return interval is appropriate. Therefore, we will likely need to conduct this research for a minimum of four years.

Juvenile Atlantic sturgeon will be captured using gill nets in similar areas of the river during late spring and summer, with a goal of marking large numbers (up to 220 individuals) of fish each year over a three-year period, and then applying both open and closed population models to observed mark-recapture data to estimate annual juvenile recruitment in the Cape Fear River.

In addition, documenting the presence and habitat use of shortnose sturgeon will be a research objective in the Cape Fear River. We anticipate the capture of shortnose sturgeon juveniles and adults will occur during our sampling efforts for Atlantic sturgeon that are described above. We do not plan to use different gears or approaches to capture shortnose sturgeon. All shortnose sturgeon will be measured, weighed, and examined for PIT tags. If no PIT tag is detected, each individual will be fitted with both an internal PIT tag and an external anchor tag (Floy/T-bar), and tissue sampled for genetic identification and aging. Details of all sampling procedures are described further below.

Neuse River

The goal of research in the Neuse River is to describe the general ecology of Atlantic sturgeon in this river. Research will initially consist of large mesh gill nets set from April to May and again from August to October in freshwater locations at least 15 km upstream of the saltwater interface. We will attempt to confirm spawning by capturing females releasing eggs.

Once adult Atlantic sturgeon are captured, the initial objectives will be to conduct mark-recapture studies and estimate survivorship of the adult population. Adult fish will receive three marks: PIT tags, T-bar tags, and fin clips for genetic identification. A subset of individuals (up to 20 individuals per year) will receive acoustic transmitters, implanted surgically. Telemetry studies will provide insight into migratory behavior, habitat use, spawn timing, spawning location, and survival. Genetic information will provide insight into whether neighboring populations are closely related and whether unique management strategies for this population are appropriate. Past research (Kahn et al. 2019) has shown that to estimate the super-population abundance of a river, one more year than the maximum spawning return interval is appropriate. Therefore, we will likely need to conduct this research for a minimum of four years.

Juvenile Atlantic sturgeon research will be initiated after confirming whether a spawning population exists. Juveniles will receive fin clips for genetic analysis. As they get larger, juveniles over 300 mm will be PIT-tagged and a subset (up to 20 individuals per year) will receive telemetry tags to monitor their movements within the river and detect any emigration events. Genetic analysis will be used to identify parentage from corresponding mark-recapture work.

In addition, documenting the presence and habitat use of shortnose sturgeon will be a research objective in the Neuse River. We anticipate the capture of shortnose sturgeon juveniles and adults will occur during our sampling efforts for Atlantic sturgeon that are described above. We do not plan to use different gears or approaches to capture shortnose sturgeon. All shortnose sturgeon will be measured, weighed, and examined for PIT tags. If no PIT tag is detected, each individual will be fitted with both an internal PIT tag and an external anchor tag (Floy/T-bar), and tissue sampled for genetic identification and aging. Details of all sampling procedures are described further below.

Tar-Pamlico River system

The goal of research in the Tar River is to describe the general ecology of Atlantic sturgeon in this river. Research will initially consist of large mesh gill nets set from April to May and again from August to October in freshwater locations at least 15 km upstream of the saltwater interface. We will attempt to confirm spawning by capturing females releasing eggs.

Once adult Atlantic sturgeon are captured, the initial objectives will be to conduct mark-recapture studies and estimate survivorship of the adult population. Adult fish will receive three marks: PIT tags, T-bar tags, and fin biopsies for genetic identification. A subset of individuals (up to 20 individuals per year) will receiver acoustic transmitters, implanted surgically. Telemetry studies will provide insight into migratory behavior, habitat use, spawn timing, spawning location, and survival. Genetic information will provide insight into whether neighboring populations are closely related and whether unique management strategies for this population are appropriate. Past research has shown that to estimate the super-population abundance of a river, one more year than the maximum spawning return interval is appropriate. Therefore, we will likely need to conduct

this research for a minimum of four years.

Juvenile Atlantic sturgeon research will be initiated after confirming whether a spawning population exists. Juveniles will receive fin clips for genetic analysis. As they get larger, juveniles over 300 mm will be PIT-tagged and a subset (up to 20 individuals per year) will receive telemetry tags to monitor their movements within the river and detect any emigration events. Genetic analysis will be used to identify parentage from corresponding mark-recapture work.

In addition, documenting the presence and habitat use of shortnose sturgeon will be a research objective in the Tar-Pamlico River system. We anticipate the capture of shortnose sturgeon juveniles and adults will occur during our sampling efforts for Atlantic sturgeon that are described above. We do not plan to use different gears or approaches to capture shortnose sturgeon. All shortnose sturgeon will be measured, weighed, and examined for PIT tags. If no PIT tag is detected, each individual will be fitted with both an internal PIT tag and an external anchor tag (Floy/T-bar), and tissue sampled for genetic identification and aging. Details of all sampling procedures are described further below.

Roanoke/Chowan River system

Fall spawning by Atlantic sturgeon in the Roanoke River was recently verified (Smith et al. 2015). However, to our knowledge no additional work has been conducted to determine the extent of the spring spawning population in this river system. Spring populations of Atlantic sturgeon occur in river systems just north and south of the Roanoke system so it seems likely that a spring spawning group still occurs in the Roanoke River, but no information on population size or demographics exists. In addition, to our knowledge, no direct Atlantic sturgeon work has been conducted in the Chowan drainage for several decades. Recently, a single fish originally tagged in the James River did make an upstream movement in the Chowan River during the fall spawning time frame. Other adults may also have been tracked moving up the Chowan. We propose to conduct exploratory sampling for adult and early stage juvenile Atlantic sturgeon within the two river systems.

We propose to initially sample for adults where the two rivers converge in the westernmost region of the Albemarle Sound. Based on timing of spring spawning north and south of this area we expect that sampling the two river mouths during March and April will be most effective. If sampling the river mouths fails to generate captures of adult Atlantic sturgeon in the spring we will adjust our methods to sample further up the rivers. Based on previous telemetry data and observations by our NC co-investigators, the fall spawning group tends to stage in the western portion of the Albemarle Sound, near the river mouths, before and after the fall spawning run. We propose to sample during these staging periods when water temperatures permit. We also plan to conduct sidescan sonar trips in each river to provide information about sturgeon habitat selection and population size. For both the spring and fall groups, all adult sturgeon will PIT-tagged, Floy-tagged, have a genetic sample taken, have a secondary fin ray removed for aging, measured for length and if possible weighed. A subset of adult Atlantic sturgeon (up to 18 individuals per year) will receive internal acoustic transmitters.

Our NC co-investigators have already demonstrated success in capturing early stage juvenile Atlantic sturgeon as bycatch in their fishery-independent gill net surveys conducted in the western Albemarle Sound. We propose to expand these efforts by conducting additional sampling to target juvenile Atlantic sturgeon. All juvenile fish will PIT-tagged, Floy-tagged, have a genetic sample taken, have a secondary fin ray removed for aging, measured for length and if possible weighed. A subset of juvenile Atlantic sturgeon (up to 5 individuals per year) will receive internal acoustic transmitters. We have already established partnerships with Dominion Power for sharing data from their fixed array of submersible Vemco receivers in the Roanoke and Chowan Rivers.

In addition, documenting the presence and habitat use of shortnose sturgeon will be a research objective in the Roanoke/Chowan River system. We anticipate the capture of shortnose sturgeon juveniles and adults will occur during our sampling efforts for Atlantic sturgeon that are described above. We do not plan to use different gears or approaches to capture shortnose sturgeon. All shortnose sturgeon will be measured, weighed, and examined for PIT tags. If no PIT tag is detected, each individual will be fitted with both an internal PIT tag and an external anchor tag (Floy/T-bar), and tissue sampled for genetic identification and aging. Details of all sampling procedures are described further below.

Description of Research Activities:

Capture methods:

Sampling at all locations will be done using anchored and drift mono- and multi-filament gillnets with stretched mesh sizes ranging from 3 to 18 inches depending on the target life stage. Gill nets will be 100-300 feet (ft.) in length and 8-36 ft. in height (some tied down to 8 ft. but no nets fished deeper than the water column). For adults, mesh sizes will range from 6 to 18 inches, while juvenile sampling will be completed with stretched mesh sizes of 3-4 inches. For juvenile sampling, trammel nets with 12-inch outer mesh size and 3-inch inner mesh panels may also be used.

To supplement capture of juvenile sturgeon small bottom trawls will be used in select areas of each river system. Trawling will be restricted in each river system to areas of juvenile concentration (primarily near the saltwater/freshwater interface), and occur mainly in channelized sections of each river. If trawling occurs in state-designated primary or secondary nursery areas, the appropriate sampling permits will include the use of this gear, but this is not anticipated given that juvenile sturgeon tend to occupy channelized habitats close to the saltwater/freshwater interface. The size of the trawl (head rope lengths between 10 and 16 ft.) and the mesh size (0.25" – 1.0" bar mesh) will be dependent on the size of the juveniles being targeted. Trawls will be towed at a maximum speed of 2.5 knots (5 miles per hour), for a maximum duration of 10 minutes. Bottom areas of anticipated sampling will be evaluated with sonar devices prior to trawling to determine if substrate is suitable and is free from snags (e.g., large woody debris). Trawling will be conducted primarily over sand substrates avoiding hard bottoms, vegetated areas, organic material, or woody debris. If a trawl net snags on bottom debris, it will be untangled immediately to reduce stress on captured animals. To lessen benthic disturbances, trawl nets will not be towed over the same location more than once in a 24 hour period using a sonar scanning device and global positioning system (GPS). Attempts will be made to minimize injury and stress of sturgeon and bycatch captured in net sets and trawls by maintaining temperature-appropriate soak and tow times.

In general, sampling time, as well as handling time, will be reduced as water temperatures increase and dissolved oxygen (D.O.) decreases, since higher water temperatures and reduced oxygen levels have been found to be stressful for Atlantic sturgeon (Moser et al. 2000; Kahn and Mohead 2010). Specifically, gill nets will not be set in waters having D.O. concentrations less than 4.5 mg/L. Netting will also cease in waters \geq 30°C. The maximum net set duration planned is 14 hours when water temperature is \geq 15°C and D.O. is \leq 4.5 mg/L, with all 14 hour unattended sets being limited to freshwater (<2 psu) habitats. Further, soak times will be limited to 2 hours at water temperatures between 15°C and 24.9°C, 1 hour at 25°C to 27.9°C, and 30 minutes between 28 - 29.9°C. For summer collections of juveniles, nets will be tended whenever water temperatures exceed 25°C. When fish are highly entangled in gear, they will be removed from nets by cutting meshes to expedite their removal from the net. After removal from capture gear, we will hold sturgeon in floating net pens, streamside-holding pens, or in onboard live wells while shielding them from direct sunlight as much as possible. We will also be prepared to accommodate larger catches of fish, including bycatch if fish become overcrowded. Any sturgeon overly stressed from capture will be resuscitated and/or allowed to recover inside a net pen or live well and also released without further handling, with exception of PIT tagging, genetic sampling, weighing, and measuring.

Handling and Processing:

To minimize stress during capture and handling, all sturgeon will be held in a net pen or in on-board live wells until they are processed at which time they would be transferred by hand to a processing station on board the research vessel. In upstream locations near spawning grounds, adults will be transferred to streamside pens where they will have more room to move while waiting to be processed. During processing, each fish will be immersed in a continuous stream of water supplied by a pump/hose assembly or kept in the river at all times. Sturgeon will be weighed on a platform scale fitted with a small waterproof cushion attached to the surface of weighing platform. Larger individuals will be weighed in a stretcher using a pulley system. After weighing, ventral and lateral fork length will be measured and then fish will be scanned for the presence of a PIT tag, and if none are detected, will be PIT tagged, Floy/t-bar tagged, and genetically tissue sampled. The total time required to complete routine procedures would be approximately two to three minutes. Following processing, fish will be returned to the net pen to ensure full recovery prior to release, except those sturgeon receiving an acoustic tag or having a

secondary fin ray removed for aging purposes. After processing, any fish not responding readily would be recovered further in the net pen by holding the fish upright and immersed in river water and gently moved in a forward motion to aid freshwater passage over the gills to stimulate the fish. When showing signs of being able to swim away strongly, the fish would be released and a spotter would watch to make sure the fish remains down and fully recovered. Total holding time may be variable depending on water temperature and the condition of each fish; however, no fish will be held longer than two hours from the time of capture to the time it is released (unless it has not been properly recovered).

PIT and Floy/T-bar Tagging:

Prior to PIT tagging, the entire dorsal surface of captured sturgeon will be scanned using a PIT tag reader to detect any existing PIT tags. All sturgeon of sufficient size (>300 mm TL) not already tagged will be tagged using 11.9 mm x 2.1 mm 134.2 kHz PIT tags injected using a 12 gauge needle at an angle of 60 to 80° in the dorsal musculature (left and just anterior to the dorsal fin). No sturgeon previously tagged with a PIT tag will be double-tagged with another PIT tag. The last step after injecting PIT tags will be to verify and record the PIT tag code with a tag reader. During the study, the rate of PIT tag retention will be documented and reported to NMFS in annual reports. In addition to PIT tags, all fish will receive an external Floy/T-bar anchor tag, inserted in the dorsal musculature near the posterior end of the dorsal fin using a standard tagging applicator. External tags will be printed with contact information to enable commercial fishermen and recreational anglers to report any incidental captures of sturgeon which will provide additional information on survival, movement, and distribution.

Tissue Sampling for Aging and Genetics:

Genetic information would be obtained from tissue samples of sturgeon to help characterize the genetic "uniqueness" of fish sampled within each North Carolina river system. This objective will also help quantify the current level of genetic diversity within the Atlantic coast population. To obtain a genetic sample, a small (1.0 cm²) soft tissue sample will be collected from the trailing margin of one of the pectoral fins or caudal fin using sharp sterilized scissors. Tissue samples will be preserved in individually labeled vials containing 95% ethanol. We will provide genetic tissue samples collected from Atlantic and shortnose sturgeon for archival purposes to the USGS Leetown Science Center located in Kearneysville, West Virginia. Proper certification, identity, and chain of custody of samples will be maintained during transfer of tissue samples.

Aging of sturgeon captured in North Carolina river systems will inform population demographics and stock structure. Aging will be accomplished through the removal and processing of marginal fin rays. The second marginal fin ray will be isolated from the fin spine and neighboring fin rays using a scalpel, by making an incision of approximately 1 cm in length on either side of the fin ray, approximately 1 cm from the pectoral fin origin. A pair of fine-point nail clippers will then be used to cut through each end of the 1 cm segment and remove the fin ray from the fin. When possible, fin rays will be removed from both the left and right sides of each individual in order to determine whether there is consistency between age estimates from both sides. Fin rays will be stored in coin envelopes until they are processed in the lab.

For laboratory processing, fin rays will be mounted in epoxy resin and allowed to harden for at least 24 hours. A Buehler IsoMet low speed saw with a single wheel will be used to acquire four transverse sections from 0.3 to 0.6 mm thick, as determined from preliminary processing of samples. Sections will be mounted on microscope slides with the mounting medium Cytoseal and examined under a dissecting microscope and digital images will be taken of each section using a real-time viewing camera. Growth bands will be counted using standard aging methods, where one band pair consists of one opaque and one translucent continuous ring.

Acoustic Tagging:

A maximum of 78 sub-adult/adult Atlantic sturgeon (>1000 mm FL) (up to 20 individuals per river; 18 in the Roanoke/Chowan system) will be surgically implanted with acoustic tags (Vemco model V16) annually within all NC river systems (Cape Fear, Neuse, Tar-Pamlico, and Roanoke/Chowan). Tagged fish will exceed the weight minimum based on the tag weight being less than two percent of the fish's total body weight. A maximum of 65 juvenile Atlantic sturgeon (<1000 mm FL) (up to 20 individuals per river; 5 in the Roanoke/Chowan system) will be surgically implanted with acoustic tags. The transmitter weight will not exceed two percent (2%) of fish total body weight; sturgeon

>560 cm FL will be tagged with VEMCO model V16-5H acoustic transmitters, and sturgeon <560 mm FL will be tagged with VEMCO model V7-4L, V9-6L, or V13-1H acoustic transmitters, depending on the weight of the individual sturgeon.

Surgery for Implanting Acoustic Tags:

The following five- to eight-minute transmitter implantation surgery, done under anesthesia, will be used. Just prior to the surgical procedure, fish will be removed from an anesthetic bath (described below) and placed on a moist V-shaped surgery cradle. A tube supplying fresh water over the gills will be placed in the mouth of the fish to maintain respiration. The incision site for implanting the tag (40 to 60 mm anterior to the pelvic fins, although the specific location would vary with fish size) will be disinfected with povidone iodine (10 percent solution). A sterile surgical packet, containing all surgical instruments and supplies, will be used to make a 25-35 mm incision in individual fish selected for surgery. Males and immature individuals will require longer incisions to avoid internal organ damage during transmitter placement. A sterilized acoustic transmitter, coated with an inert polymer compound, will be inserted into the surgical openings of sturgeon and the incision closed with either continuous or interrupted sutures of 3-0 polydioxanone (PDS) and treated with povidone iodine to prevent infection. Post-surgery fish will be held in an aerated holding tank and released into the live well or net pen to recover from anesthesia. Based on the implantation of similar acoustic tags in other fish, we estimate the surgical procedure will require approximately 5 - 8 minutes to complete, with a total holding time (anesthesia induction, surgery, and recovery) of 20 minutes or less. Internal tags will not be implanted in unhealthy or stressed fish.

Anesthesia for Implanting Acoustic Tags:

Atlantic sturgeon selected for transmitter implantation will not be tagged at temperatures above 27°C or below 7°C. Each sturgeon prepared for surgery will be sedated in a bath solution of up to 50 mg/L of tricaine methane sulfonate (MS-222) buffered to neutral pH with sodium bicarbonate. Upon reaching a sedated anesthesia (i.e., slow movement and breathing reduced) animals will be removed from the solution and placed on a surgery cradle to surgically implant the tag. Anesthetic induction and recovery time will vary between three and five minutes depending in fish size, but will be appropriately monitored for Atlantic sturgeon under the specific water temperature and oxygen conditions present.

Recaptured sturgeon: If sturgeon are recaptured during the same reporting year (January 1 - December 31), individuals will be scanned for PIT tags, measured, weighed, and released. No additional procedures will be performed on these individuals.

References:

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Supplemental Information

Status of Species:	Atlantic sturgeon (<i>Acipenser oxyrinchus oxyrinchus</i>): List as Endangered ESA Carolina DPS; rel. common Shortnose sturgeon (<i>Acipenser brevirostrum</i>): Listed as Endangered ESA; rare/extirpated in NC Green sea turtle (<i>Chelonia mydas</i>): Listed as Threatened ESA North Atlantic DPS; rel. common Kemp's ridley sea turtle (<i>Lepidochelys kempii</i>): Listed Endangered ESA; rel. common Leatherback sea turtle (<i>Dermochelys coriacea</i>): Listed Endangered ESA; rare Hawksbill sea turtle (<i>Eretmochelys imbricata</i>): Listed Endangered ESA; extremely rare Loggerhead turtle (<i>Caretta caretta</i>): Listed as Threatened ESA Northwest Atlantic DPS; rel. common Florida manatee (<i>Trichechus manatus</i>): ESA listing Endangered and MMPA, very rare Bottlenose dolphin (<i>Tursiops truncatus</i>): MMPA protection; occur rarely within area
Intentional Lethal Take:	There is no intentional lethal take proposed in this study. While unintentional mortality or serious injury is possible, given short soak times & handling care we anticipate no mortality or serious harm.
Anticipated Effects on Animals:	<p>Research Risks to Animals:</p> <p>The risks to Atlantic and shortnose sturgeon by this project occur for six discrete activities: capture, handling, genetic tissue sampling, secondary fin ray removal, external floy/t-bar tagging, PIT tagging, anesthesia, and surgery to implant acoustic tags.</p> <p>Capture: Sturgeon captured in the proposed sampling gears may be subject to stress and slight injury. The primary stressors we have encountered has been low D.O. and high water temperatures. As described in Moser (2000), sturgeon are a hardy fish and can withstand many hours within gill nets; however, gill nets of incorrect mesh sizes for the fish targeted have the potential for restricting gill covers resulting in suffocations. Trawls can cause physical injury to fishes, and also force gill covers closed preventing respiration. Fish can also be physiologically taxed from trying to swim against the direction of the towed net. Short trawl durations (10 minutes) and slow tow speeds (~ 2.5 knots) should minimize the possibility of stress and injury to any sturgeon captured during trawling operations.</p> <p>Handling/Restraint: Sturgeon may be subjected to additional stress when kept captive and handled before tagging. The use of tricaine methane sulfonate (MS-222) to anesthetize fish is recommended in Moser et al. (2000) and has been used in other telemetry studies. There is a risk to individual fish during the application of MS-222 due to</p>

overexposing or overdosing sturgeon. Fish could also experience delayed recovery from anesthesia.

Tissue sampling/Surgery/Anesthesia:

The sampling of fin ray tissue for genetics and aging, insertion of PIT and external tags, and the surgical implantation of acoustic transmitters may cause additional stress to sturgeon that are captured and handled. Surgery and anesthesia could result in direct/indirect mortality from adverse recovery. Tagging methods puncture the skin of the fish and may potentially be a site of infection.

Cumulative Stress:

Each of these activities individually may cause no externally visible sign of stress. However, the cumulative impact of all of these activities could cause visible signs of stress (i.e., inflated swim bladder, severe redness and hemorrhage under the skin, or excess mucus production in captured fish) or delayed stress causing fish to suffer.

Risks to Non-listed Bycatch:

It is possible that our capture activities (i.e., gillnetting and trawling) may result in unintentional capture and/or mortality of the non-target species listed below; however, bycatch is typically released alive and we anticipate very few fish harmed in the process due to the proposed netting methods.

Estuarine/coastal fish species: kingfishes (*Menticirrhus* spp.), bluefish (*Pomatomus saltatrix*), weakfish (*Cynoscion regalis*), stingrays (Dasyatidae), skates (Rajidae), horseshoe crabs (*Limulus polyphemus*), southern flounder (*Paralichthys lethostigma*), Atlantic croaker (*Micropogonias undulatus*), red drum (*Sciaenops ocellatus*), and gray trout (*Cynoscion regalis*).

Anadromous fish species: blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), hickory shad (*Alosa mediocris*), American shad (*Alosa sapidissima*), and striped bass (*Morone saxatilis*).

Riverine fish species: channel catfish (*Ictalurus punctatus*), blue catfish (*Ictalurus furcatus*), white catfish (*Ameiurus catus*), flathead catfish (*Pylodictis olivaris*), white perch (*Morone americana*), yellow perch (*Perca flavescens*), largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), redbreast sunfish (*Lepomis auritus*), warmouth (*Lepomis gulosus*), chain pickerel (*Esox niger*), and redfin pickerel (*Esox americanus*), longnose gar (*Lepisosteus osseus*).

Measures to Minimize Effects:

Efforts to minimize risk

Capture, Handling, and Holding:

Gillnet sampling times, trawl tow durations, as well as handling times, will be reduced as water temperatures increase and D.O. decreases, since higher water temperatures and reduced oxygen levels have been found to be stressful for Atlantic and shortnose sturgeon (Moser et al. 2000, Kahn and Mohead 2010). Specifically, gillnets will not be set in waters having D.O. concentrations less than 4.5 mg/L. Netting will also cease in waters $\geq 30^{\circ}\text{C}$. The maximum net set duration planned is 14 hours when water temperature is $< 15^{\circ}\text{C}$ in freshwater (<2 psu), 2 hours at water temperatures between 15°C and 24.9°C , 1 hour between 25°C and 27.9°C , and 30 minutes between 28°C and 29.9°C . At water temperatures above 25°C (i.e., summer sampling for juvenile sturgeon), all nets will be tended continuously. When fish are highly entangled in gear, meshes will be cut to expedite fish removal from the net. Trawl durations (10 minutes) and tow speeds (~ 2.5 knots) will be restricted during all trawling operations to reduce the possibility of physical injury or physiological stress. After removal from capture gear, we will hold sturgeon in floating

net pen, streamside-holding pens, or in onboard live wells while shielding them from direct sunlight as much as possible. We will also be prepared to accommodate larger catches of fish, including bycatch if fish become overcrowded. Any sturgeon overly stressed from capture will be resuscitated and/or allowed to recover inside a net pen or live well and also released without further handling, with exception of PIT tagging, weighing, and measuring.

Handling/Restraint:

When fish are onboard the research vessel for processing, the flow-through holding tanks will allow for total replacement of water volume every 15 minutes. Handling of fish will be kept to a minimum to reduce risks. Fish will be removed from the net and placed in holding tank and quickly measured, weighed, tagged, and immediately returned to the water. Fish will be weighed, measured and tagged on a table frame supporting the length of the fish. Further, to minimize stress, the total holding time of sturgeon after removal from the capture gear will not exceed two hours, unless the fish has not recovered from anesthesia; and the total holding time after removal from the capture gear, will not exceed 30 minutes at water temperatures $>28^{\circ}\text{C}$. Further, if water temperature is $>28^{\circ}\text{C}$, or $<7^{\circ}\text{C}$, research would be limited to non-invasive procedures (e.g., PIT tagging, length and weight measurements, and tissue sampling for aging and genetics). No sturgeon will be acoustically-tagged outside of this water temperature range.

Marking/Tissue sampling/Surgery/Anesthesia:

Atlantic sturgeon undergoing anesthesia will be handled with gloves to reduce the transfer of MS-222 solutions to other fishes and researchers. To minimize stress from the anesthetic, fish will be exposed to a light sedation dose of 50 mg/L of MS-222 for the minimum time needed to reach an appropriate sedation level. If a sturgeon is observed having an adverse reaction during the sedation, work will stop and the fish immediately placed in a floating net pen or vessel live well to be allowed to recover under close observation. Surgical instruments and internal tags will be sterilized prior to surgery. The incision area will be swabbed with betadine prior to making the incision. The suture material used will be absorbable into the tissue or dissolvable as the incision heals. A petroleum jelly-betadine mixture will be spread over the sutured area to deter bacteria from entering the wound. Surgery to implant transmitters will only be attempted when fish are in excellent condition and will not be attempted on fish on the spawning ground, nor if the water temperature exceeds 27°C (to reduce handling stress) or is less than 7°C (incisions do not heal rapidly in low temperatures).

Minimizing Risks to Sea Turtles:

Green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles, although more tropical, are all highly migratory and travel widely throughout the Atlantic Ocean and into sounds and bays, including the coastal waters of North Carolina. Of the listed turtle species potentially occurring in our proposed action areas, we would consider Kemp's ridley, loggerhead, and green turtles to be most common. Although our actions could potentially capture a sea turtle with a gill net, our short net durations and practice of attending our nets during the warmer season when turtles would be typically present, would greatly reduce their risk caused by our activity. In each of the action areas, we will be primarily fishing upriver from the estuarine regions and should effectively avoid all turtles. However, in rare circumstances, if a turtle is seen in the action area before a net is set, the deployment would be delayed until the turtle is no longer seen in the action area. If a turtle is captured in one of our nets, we would pull the net immediately to free the animal and notify the NCWRC sea turtle stranding coordinator with details of the interaction.

Marine Mammals (Florida manatee and bottlenose dolphin):

Unintended harassment of these non-target marine mammals is estimated to be minor given their minimal occurrence in our proposed action areas. Further sturgeon generally make use of different habitats within the rivers and thus our activities are not likely to interact with marine mammals. Even though occurrences of manatee and bottlenose dolphin are unlikely in our action areas, we will be prepared to not deploy nets in waters when they are observed within the vicinity of our research. Any marine mammals sighted would be allowed to either leave or pass through the area safely before netting is initiated. Also, should any marine mammals enter the

research area after the nets have been set, the lead line would be raised and dropped in an attempt to make marine mammals in the vicinity aware of the net. If marine mammals remained within the vicinity of the research area, nets would be removed. Beyond these measures, we will follow all recommended NMFS measures avoiding takes of manatee and dolphin.

Minimizing Risk to Non-Listed By-catch Fish Species:

Due to the nature of our netting, we would expect some other non-target species would become enmeshed during our activities. However, since nets will typically be checked at short intervals we expect that virtually all by-catch will be released alive.

Resources Needed to Accomplish Objectives: Principal investigator Scharf has substantial experience in capture, handling, and telemetry of coastal and riverine fishes, and has worked extensively in several NC river systems using the same gears proposed for use in capturing sturgeon. In addition, Dr. Scharf and members of his research team have recently accompanied SCDNR staff (B. Post and D. Hood) on field sampling trips to capture, handle, tissue-sample, and acoustically tag Atlantic sturgeon of multiple life stages. NCDMF co-investigators Loeffler and Facendola each have considerable experience capturing and tagging sturgeon in NC rivers that was conducted under a previous permit. Mr. Loeffler is also a member of the ASMFC Atlantic sturgeon Technical Committee. Co-investigators Balazik and Kahn have extensive experience capturing, handling, and tagging sturgeon in Virginia river systems; they are each considered experts in the field of sturgeon research. Co-investigator McCargo is the Anadromous Fish coordinator for the NCWRC and has cooperated on past sturgeon research within NC systems; co-investigator McCargo plans to assist when needed but does not request permission to process sturgeon unsupervised.

Disposition of Tissues: Tissue samples (a 1.0 cm² pectoral fin clip in buffer solution) will be collected for genetic analysis and provided to the NOAA sturgeon DNA repository at the USGS Leetown Science Center in Kearneysville, West Virginia.

Public Availability of Product/Publications: Results will be annually reported to NMFS, published in interim and final reports as a condition of our permit, and also yearly to the ASMFC. Tagging results will be available to the scientific community through the Atlantic Coast Sturgeon Tagging Database maintained by the USFWS. Study results will be presented at scientific meetings and published in primary fisheries literature if warranted.

Location/Take Information

Location

Research Area: Atlantic Ocean **State:** NC **Stream Name:** Cape Fear River

Location Description: Cape Fear River, including all tributaries, from the mouth to Lock and Dam #2, near Elizabethtown

Take Information

Line	Ver	Species	Listing Unit/Stock	Production /Origin	Life Stage	Sex	Expected Take	Takes Per Animal	Take Action	Observe /Collect Method	Procedure	Transport Record	Begin Date	End Date
1		Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Subadult/ Adult	Unknown	20	1	Capture/Handle/Release	Net, Gill	Anesthetize (e.g. MS-222); Instrument, internal (e.g., VHF, sonic); Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample,	N/A	1/31/2020	1/31/2025

										fin clip (genetic); Sample, fin ray clip (second ray); Weigh			
2	Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Subadult/Adult	Unknown	155	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
3	Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Juvenile	Unknown	20	1	Capture/Handle/Release	Net, Gill	Anesthetize (e.g. MS-222); Instrument, internal (e.g., VHF, sonic); Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
Details: Gill net capture of juvenile Atlantic sturgeon will be supplemented by otter trawling (details outlined above in Capture Methods).													
4	Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Juvenile	Unknown	240	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
Details: Gill net capture of juvenile Atlantic sturgeon will be supplemented by otter trawling (details outlined above in Capture Methods). Marked individuals may be recaptured for abundance estimation, and these will be considered as additional takes.													
5	Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	Subadult/Adult	Unknown	15	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
6	Sturgeon, shortnose	Range-wide (NMFS	Wild	Juvenile	Unknown	15	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample,	N/A	1/31/2020	1/31/2025

			Endangered)							fin ray clip (second ray); Weigh			
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Location

Research Area: Atlantic Ocean **State:** NC **Stream Name:** Neuse River

Location Description: Neuse River and tributaries, between Goldsboro, NC and the mouth of the river

Take Information

Line	Ver	Species	Listing Unit/Stock	Production /Origin	Life Stage	Sex	Expected Take	Takes Per Animal	Take Action	Observe /Collect Method	Procedure	Transport Record	Begin Date	End Date
1		Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Subadult/Adult	Unknown	20	1	Capture/Handle/Release	Net, Gill	Anesthetize (e.g. MS-222); Instrument, internal (e.g., VHF, sonic); Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
2		Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Subadult/Adult	Unknown	155	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
3		Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Juvenile	Unknown	20	1	Capture/Handle/Release	Net, Gill	Anesthetize (e.g. MS-222); Instrument, internal (e.g., VHF, sonic); Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
Details: Gill net capture of juvenile Atlantic sturgeon will be supplemented by otter trawling (details outlined above in Capture Methods).														

4	Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Juvenile	Unknown	80	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
Details: Gill net capture of juvenile Atlantic sturgeon will be supplemented by otter trawling (details outlined above in Capture Methods).													
5	Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	Subadult/Adult	Unknown	15	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
6	Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	Juvenile	Unknown	15	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025

Location

Research Area: Atlantic Ocean **State:** NC **Stream Name:** Tar/Pamlico River system

Location Description: Tar/Pamlico Rivers and tributaries from Rocky Mount, NC to the mouth of the Pamlico River

Take Information

Line	Ver	Species	Listing Unit/Stock	Production /Origin	Life Stage	Sex	Expected Take	Takes Per Animal	Take Action	Observe /Collect Method	Procedure	Transport Record	Begin Date	End Date
1		Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Subadult/Adult	Unknown	20	1	Capture/Handle/Release	Net, Gill	Anesthetize (e.g. MS-222); Instrument, internal (e.g., VHF, sonic); Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025

2	Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Subadult/Adult	Unknown	155	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
3	Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Juvenile	Unknown	20	1	Capture/Handle/Release	Net, Gill	Anesthetize (e.g. MS-222); Instrument, internal (e.g., VHF, sonic); Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
Details: Gill net capture of juvenile Atlantic sturgeon will be supplemented by otter trawling (details outlined above in Capture Methods).													
4	Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Juvenile	Unknown	80	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
Details: Gill net capture of juvenile Atlantic sturgeon will be supplemented by otter trawling (details outlined above in Capture Methods).													
5	Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	Subadult/Adult	Unknown	15	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
6	Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	Juvenile	Unknown	15	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025

Location

Research Area: Atlantic Ocean **State:** NC **Stream Name:** Roanoke/Chowan River system

Location Description: Roanoke/Chowan River system and tributaries extending from Roanoke Rapids, NC to 4 miles outside the mouth of the Roanoke River into Albemarle Sound

Take Information

Line	Ver	Species	Listing Unit/Stock	Production /Origin	Life Stage	Sex	Expected Take	Takes Per Animal	Take Action	Observe /Collect Method	Procedure	Transport Record	Begin Date	End Date
1		Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Subadult/Adult	Unknown	18	1	Capture/Handle/Release	Net, Gill	Anesthetize (e.g. MS-222); Instrument, internal (e.g., VHF, sonic); Mark, Floy T-bar; Mark, PIT tag; Measure; Other; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
2		Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Subadult/Adult	Unknown	157	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Other; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
3		Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Juvenile	Unknown	5	1	Capture/Handle/Release	Net, Gill	Anesthetize (e.g. MS-222); Instrument, internal (e.g., VHF, sonic); Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
Details: Gill net capture of juvenile Atlantic sturgeon will be supplemented by otter trawling (details outlined above in Capture Methods).														
4		Sturgeon, Atlantic	Carolina (NMFS Endangered)	Wild	Juvenile	Unknown	95	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample,	N/A	1/31/2020	1/31/2025

		Endangered)								fin ray clip (second ray); Weigh			
	Details: Gill net capture of juvenile Atlantic sturgeon will be supplemented by otter trawling (details outlined above in Capture Methods).												
5	Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	Subadult/Adult	Unknown	15	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025
6	Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	Juvenile	Unknown	15	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip (genetic); Sample, fin ray clip (second ray); Weigh	N/A	1/31/2020	1/31/2025

NEPA Checklist

1) If your activities will involve equipment (e.g., scientific instruments) or techniques that are new, untested, or otherwise have unknown or uncertain impacts on the biological or physical environment , please discuss the degree to which they are likely to be adopted by others for similar activities or applied more broadly.

Telemetry methodology and techniques combined with traditional netting protocol, to capture sturgeon, would not be considered new.

2) If your activities involve collecting, handling, or transporting potentially infectious agents or pathogens (e.g., biological specimens such as live animals or blood), or using or transporting hazardous substances (e.g., toxic chemicals), provide a description of the protocols you will use to ensure public health and human safety are not adversely affected, such as by spread of zoonotic diseases or contamination of food or water supplies.

The anesthetic MS-222 is a potential slight irritant to the eyes, respiratory system and skin when allowed to become airborne. The chemical will be handled with care and kept contained while not in use. It will be pre-measured prior to sampling in the field, and it will be immediately dissolved into an aqueous solution of low concentrations. Researchers will wear latex gloves when handling fish anaesthetized with MS-222. First aid measures involve flushing eyes, mouth and/or skin with copious amounts of water. A physician will be contacted if negative reactions persist. Tissue samples for genetic analysis will be stored in appropriate preservative (e.g., ethanol) in plastic vials that are resistant to shatter. Minor skin contact with tissue preservative poses no considerable health risk.

3) Describe the physical characteristics of your project location, including whether you will be working in or near unique geographic areas such as state or National Marine Sanctuaries, Marine Protected Areas, Parks or Wilderness Areas, Wildlife Refuges, Wild and Scenic Rivers, designated Critical Habitat for endangered or threatened species, Essential Fish Habitat, etc. Discuss how your activities could impact the physical environment, such as by direct alteration of substrate during use of bottom trawls, setting nets, anchoring vessels or buoys, erecting blinds or other structures, or ingress and egress of researchers, and measures you will take to minimize these impacts.

Sampling in NC Rivers will not impact the terrestrial areas as it will occur away from the boundaries in riverine habitat. Part of our studies will potentially occur in areas having EFH for federally managed species such as red drum and flounder, however, the interaction of gill netting activity with the bottom substrate and boating activities on the surface are not expected to impact the EFH in any appreciable way. Bottom trawling will be limited in spatial scope to areas that concentrate juvenile sturgeon (primarily the freshwater/saltwater interface) and can only occur over sandy bottoms that are free of debris. Tow speeds will be slow (2.5 knots) and tow durations kept short (10 minutes maximum) to minimize any potential bottom

disturbance. Importantly, the trawl gear will consist of small trawls (10-16 ft. head rope length) that have minimal impacts to bottom structure, particularly when fished over sandy bottom types, thus impacts of limited bottom trawling to Atlantic sturgeon critical habitats are expected to be minimal.

4) Briefly describe important scientific, cultural, or historic resources (e.g., archeological resources, animals used for subsistence, sites listed in or eligible for listing in the National Register of Historic Places) in your project area and discuss measures you will take to ensure your work does not cause loss or destruction of such resources. If your activity will target marine mammals in Alaska or Washington, discuss measures you will take to ensure your project does not adversely affect the availability (e.g., distribution, abundance) or suitability (e.g., food safety) of these animals for subsistence uses.

Our activities will not occur in the above mentioned areas.

5) Discuss whether your project involves activities known or suspected of introducing or spreading invasive species, intentionally or not, (e.g., transporting animals or tissues, discharging ballast water, use of equipment at multiple sites). Describe measures you would take to prevent the possible introduction or spread of non-indigenous or invasive species, including plants, animals, microbes, or other biological agents.

Our boat trailer will be cleaned and the bilge will be flushed prior to moving to a new watershed area to prevent spread of unwanted invasive species. We will provide samples of genetic tissue, taken from shortnose and Atlantic sturgeon and preserved in ethyl alcohol vials, to the NOAA NOS archive in Leetown, WV as part of our research activities. We would not expect possible spread of an invasive species resulting from this activity.

Project Contacts

Responsible Party: Frederick Scharf

Primary Contact: Frederick Scharf

Principal Investigator: Frederick Scharf

Other Personnel

Name	Role(s)
Matthew Balazik	Co-Investigator
Aaron Bunch	Co-Investigator
Mason S. Collins	Co-Investigator
Joseph Facendola	Co-Investigator
Matt Fisher	Co-Investigator
Chris Hager	Co-Investigator
Jason E Kahn	Co-Investigator
Michael S. Loeffler	Co-Investigator

Attachments

[Application Archive](#) - (Added Feb 5, 2020)

[Certification of Identity](#) - (Added Aug 1, 2019)

Contact - Chris Hager (Added May 28, 2015)
Contact - Chris Hager (Added May 28, 2015)
Contact - Chris Hager (Added Jun 26, 2018)
Contact - Frederick Scharf (Added Nov 26, 2019)
Contact - Frederick Scharf (Added Aug 1, 2019)
Contact - Jason E Kahn (Added Jun 25, 2019)
Contact - Jason E Kahn (Added Nov 26, 2019)
Contact - Joseph Facendola (Added Nov 26, 2019)
Contact - Matt Fisher (Added Apr 12, 2011)
Contact - Matt Fisher (Added Aug 3, 2016)
Contact - Matt Fisher (Added Apr 20, 2015)
Contact - Matthew Balazik (Added Feb 15, 2013)
Contact - Matthew Balazik (Added Nov 26, 2019)
Contact - Michael S. Loeffler (Added Nov 26, 2019)
Contact - Michael S. Loeffler (Added Oct 1, 2009)
References - (Added Jul 31, 2019)
Resources Needed - (Added Jul 31, 2019)

Status

Application Status: Application Complete
Date Submitted: August 1, 2019
Date Completed: December 3, 2019
FR Notice of Receipt Published: December 11, 2019 **Number:** 2019-26666
Comment Period Closed: January 10, 2020 **Comments Received:** No **Comments Addressed:** No
Last Date Archived: May 26, 2021

• ESA Section 10(a)(1)(A) permit (other)

Current Status: Issued **Status Date:** January 31, 2020

Section 7 Consultation: Programmatic

NEPA Analysis: Categorical Exclusion

Expire Date: January 31, 2025

Analyst Information:

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|-------------------|--------------------------------|
| 1) Erin Markin | Phone: (301)427-8416 |
| | Email: erin.markin@noaa.gov |
| 2) Malcolm Mohead | Phone: (301)427-8427 |
| | Fax: (301)713-0376 |
| | Email: Malcolm.Mohead@noaa.gov |

Modification Requests

Modifications Requested

Number	Title	Description	Status	Date Submitted	Date Issued	Issued Version
1	Add investigators	I would like to add Chris Hager and Matt Fisher as co-Investigators on our NC permit for sturgeon research. Both of them are experienced sturgeon researchers and should be approved to conduct all procedures contained in our permit unsupervised, including capture, handling, acoustic (internal tagging), PIT tagging, and obtaining fin clips for aging and genetic analyses.	Issued	07/20/2020	07/27/2020	
2	Placement of additional transmitter during surgery	We have a collaborative research opportunity with colleagues from Clemson University that will be studying fine scale movements of migratory fishes near a fish bypass structure in the Cape Fear River beginning in spring 2021. They will be using a system of acoustic receivers and transmitters with high spatial resolution to examine behavior of striped bass and American shad as they are attempting to move through the bypass structure. We would like to take this opportunity to also examine the fine scale movements of Atlantic sturgeon around this structure, which would require us to insert an additional transmitter into the body cavity during our tagging surgeries (the transmitters we are using to examine spawning migrations operate at a different frequency 69kHz vs. 307kHz). The amendment will not change our tagging surgery protocols in any way, we would just be placing 2 tags inside the body cavity of a subset of fish (n = 10). The additional tags are very small (HTI model 795-L, 16 mm diameter, 48 mm length, 7.3 g in water) relative to the Vemco model V16 tags (95mm in length and 15-17g weight in water) that we will be placing in adult and subadult sturgeon. This means that we will still be far below the 2% tag weight/body weight threshold. Given the size of the body cavity of subadult and adult sturgeon, we would not expect any negative impacts from the inclusion of this 2nd smaller tag. The battery life of the HTI tag will be approximately 2.5 years and we have confirmed no tag interference will occur with the Vemco V16 tags. The maximum number of fish receiving the additional tag would be 10 during both 2021 and 2022, limited by the number of tags that can be supplied by the Clemson research team.	Issued	01/27/2021	02/05/2021	
3	Additional of personnel	I request a modification to add personnel to our permit. I would like to add Mason Collins and Aaron Bunch. Each of these individuals are currently enrolled in graduate programs at UNCW or Clemson and are completing research in the lower Cape Fear River. They each have extensive capture, handling, and surgical experience with fishes collected in a variety of ecosystems, and they have received training on handling and surgical approaches for Atlantic sturgeon by Fred Scharf and Joe Facendola (each are current investigators on the permit), and also from Dr. Dewayne Fox, an experienced sturgeon researcher from Delaware State University.	Issued	05/10/2021	05/25/2021	

Reports

Reports Required

Nbr	Report Type	Report Period		Date Due	Status	Date Received
		Start Date	End Date			

1	Annual	02/01/2020	12/31/2020	02/01/2021	Submitted	01/28/2021
2	Annual	01/01/2021	12/31/2021	02/01/2022	N/A	
3	Annual	01/01/2022	12/31/2022	02/01/2023	N/A	
4	Annual	01/01/2023	12/31/2023	02/01/2024	N/A	
5	Combined Annual/Final	01/01/2024	01/31/2025	03/01/2025	N/A	